Goddard Space Flight Center SPI

GSFC

Scheduling Your Project

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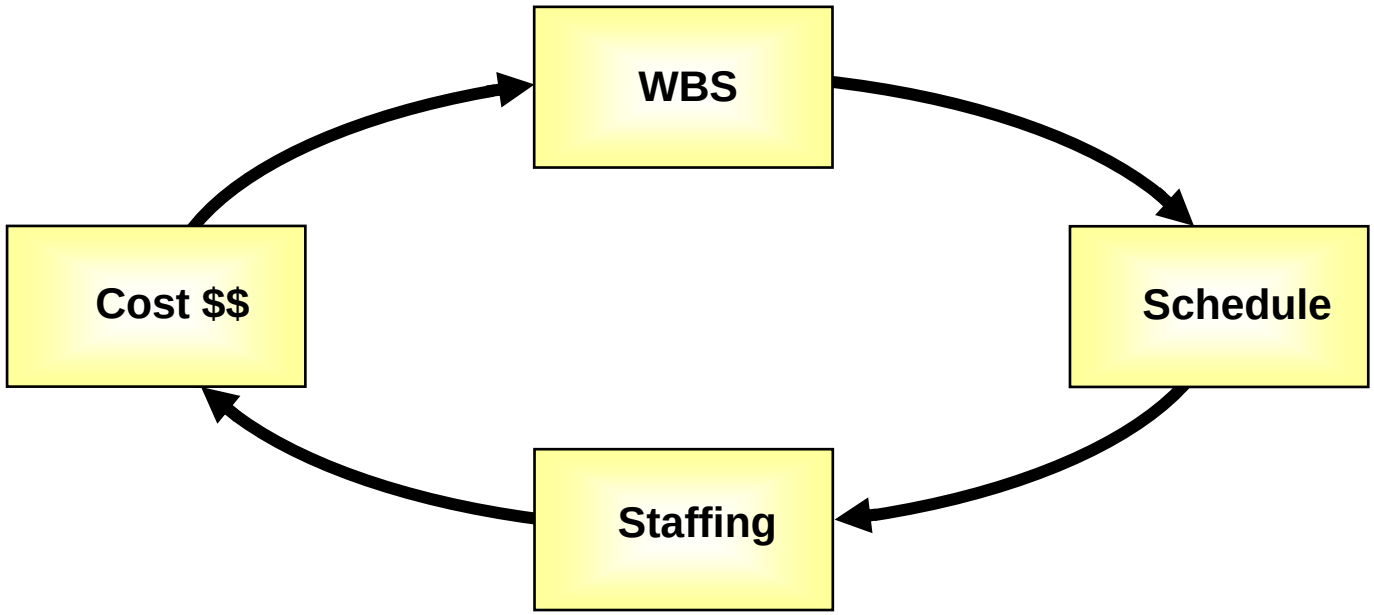
Software Process Improvement (SPI) Project

Purpose and Objectives

- **Purpose: Provide guidance on scheduling your project and allocating resources to each work element**
- **Objective - After this class you should know:**
  - **The different levels of project schedules**
  - **How to create project schedules using the WBS**
  - **How to allocate staffing resources to the WBS work elements**
  - **How to organize the staffing resources**
  - **Some of the pitfalls in scheduling work and allocating resources**

If This Is About Scheduling, Why Talk About Staffing?

- The WBS drives the schedule …
  - … but the schedule will drive the staffing profile …
  - … and the staffing profile drives the cost …
  - … which may influence the amount of work you can do in the WBS..
  - … which can cause the schedule to change …
- So you need to think about all three before your schedule is done



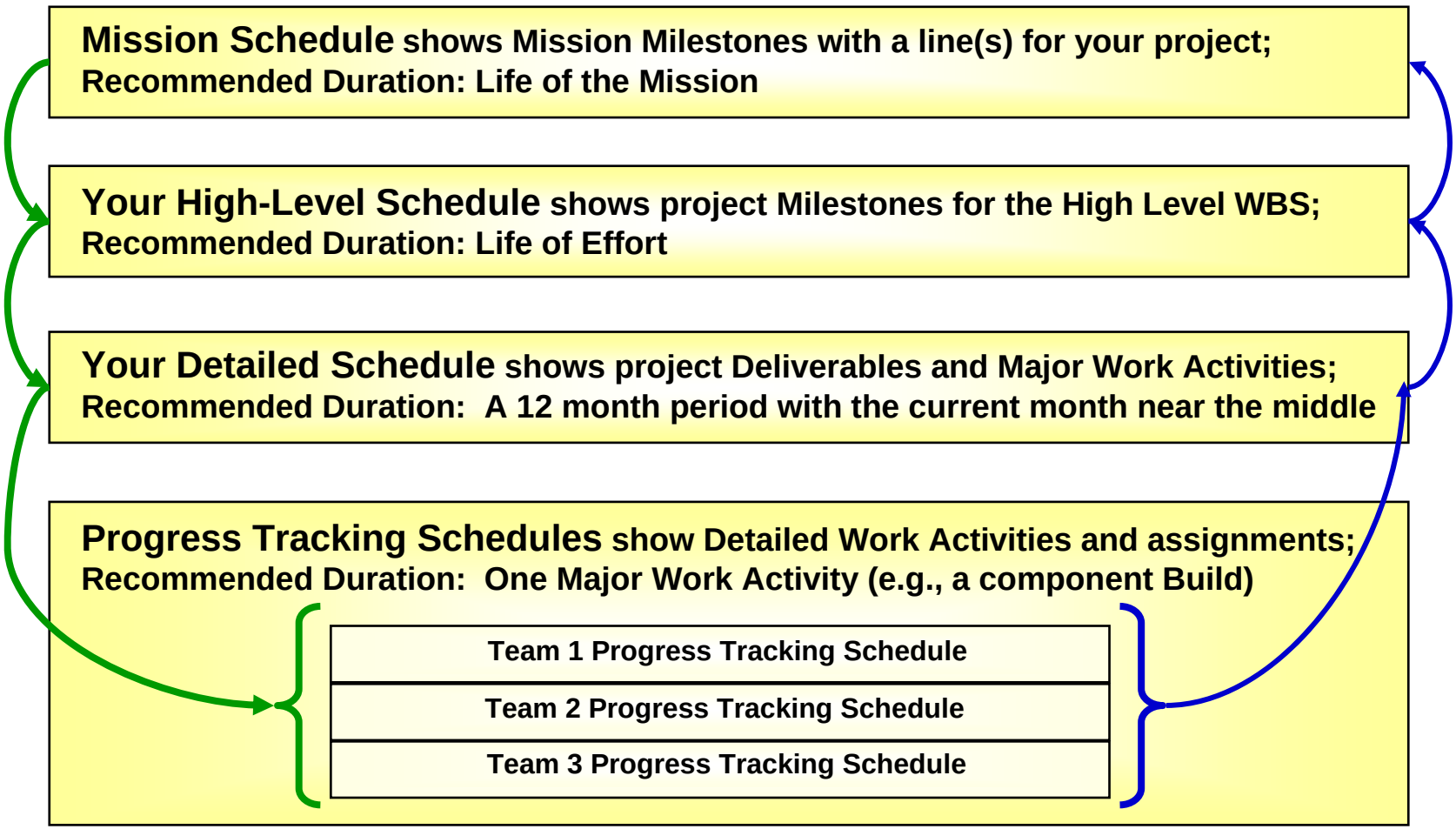
The Levels of Schedules

- **Different schedules may be used for different purposes**
  - **Mission Schedule - shows project status relative to the Mission**
  - **Your High-level Schedule - shows an overview of project status**
  - **Your Detailed Schedule - provides the "reporting" level view of status**
  - **Your Progress Tracking schedules - Tracks status at the lowest level**
    - **Point Counting Schedules, Earned Value (EV) schedule sheets**
- **All 4 schedules must be in synch**
  - **The PDL must ensure the high level schedule is in synch with the mission schedule**
  - **The PDL must ensure detailed schedules are in synch with high level schedules**
  - **Each Lead must ensure Progress Tracking schedules are in synch with Detailed Schedules**

How the Schedules Fit Together

Plan major activities based on higher-level schedules and work down as detail is added

Collect status at lower levels and roll it up



So How Do You Start?

- The Mission Schedule is normally given to you
  - If not, use defined schedule constraints … review dates, build dates, release date(s)
- Assess the WBS and determine
  - Activities that you want on the High Level Schedule (usually those at WBS level 2 or 3 and higher)
  - Low-level activities that you want to be tracked with a progress tracking tool like EV or the Point Counting Tool (usually level 4 or 5 and below)
  - The Detailed Schedule should have the activities above those in progress tracking schedules

First Identify High Level Schedule Elements …

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3	Subsystem Development
3.1	Architecture Design
3.1.1	Define Requirements
3.1.1.1	Meet Stakeholders to Understand L3 Req
3.1.1.2	Analyze Level 3 Req
3.1.1.3	Allocate L3 Reqs to Subsystems
3.1.1.4	Baseline Level 3 Requirements
3.1.1.5	Conduct Software Req Review
3.1.1.6	Capture and Track SRR RFAs
3.1.2	Develop Preliminary Design Pkg
3.1.2.1	Conduct Prelim Design Review
3.1.2.2	Capture and Track PDR RFAs
3.1.3	Develop Detailed Design Pkg
3.1.3.1	Conduct Crit Design Review
3.1.3.2	Capture and Track CDR RFAs
3.2	Develop Software
3.2.1	Develop C&DH Level 4 Requi
3.2.2	Develop C&DH Software
3.2.2.1	PSE Build 1.0
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	er's Gu
	uild
	ion Tes
	uild
	ion Test
	uild
	ion Test
3.2.2.8	Create/Update S/COMM User's Guide

2	Engineering
2.1	Systems Engineering
2.1.1	Develop FSW System Concept
2.1.2	Define Interface Requirements
2.1.2.1	Receive 1553 ICD
2.1.2.2	Receive Core SDN HW/SW ICD
2.1.2.3	Receive ACE HW/SW ICD
2.1.2.4	Receive GCE HW/SW ICD
2.1.2.5	Receive PSE HW/SW ICD
2.1.2.6	Receive S/COMM HW/SW ICD
2.1.2.7	Receive Bulk Memory Card HW/SW ICD
2.2	Dev/Test Environment Eng
2.2.1	Configure FSW Development Tools
2.2.2	Integrate ACS Test String
2.2.3	Integrate C/DH Test String

1	ABC Flight Software Management
1.1	Plan ABC FSW
1.1.1	Plan Technical Approach
1.1.1.1	Refine Std FSB WBS for ABC
1.1.1.2	Perform Init Make/Buy/Reuse Analysis
1.1.1.3	Refine Std FSB Life-Cycle for ABC
1.1.1.4	Plan Acquisitions / Receivables
1.1.1.5	Plan Life Cycle Phases
1.1.1.6	Plan Builds
1.1.2	Plan Management Approach
1.1.2.1	Establish Organization
1.1.2.2	Plan Metrics Approach
1.1.2.2.1	Establish Metrics Objectives
1.1.2.2.2	Review/Select FSW Metrics
1.1.2.2.3	Select Metrics Tools/Repository
1.1.2.3	Plan Stakeholder Approach
1.1.2.4	Plan Data Mgmt Approach
1.1.2.5	Plan Training Approach

Starting with the detailed WBS for ABC …

… identify High Level Schedule activities

1	ABC Flight Software Management
1.1	Plan ABC FSW
1.2	Monitor & Control Activities
1.3	Manage Configurations
1.4	Support Quality Assurance
1.5	Stakeholder Coordination
1.6	Manage Procurements
2	Engineering
2.1	Systems Engineering
2.2	Dev/Test Environment Eng **
3	Subsystem Development
3.1	Architecture Design **
3.2	Develop Software
4	Test FSW
4.1	Plan Test Program
4.2	Plan Build Test Scenarios and Procs
4.3	Build Verification Test and Report
4.4	Perform System/Acceptance Testing

Then Plan the Progress Tracking …

3	Subsystem Development
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3.1.2.2	Capture and Track PDR RFAs
3.1.3	Develop Detailed Design Pkg
3.1.3.1	Conduct Critical Design Review
3.1.3.2	Capture and Track CDR RFAs
3.2	Develop Software
3.2.1	Develop C&DH Level 4 Requirements
3.2.2	Develop C&DH Software
3.2.2.1	PSE Build 1.0
3.2.2.1.1	Design and Develop Build
3.2.2.1.2	Perform Build Integration Test
3.2.2.2	PSE Build 2.0
3.2.2.2.1	Design and Develop Build
3.2.2.2.2	Perform Build Integration Test
3.2.2.3	PSE Build 3.0
3.2.2.3.1	Design and Develop Build
3.2.2.3.2	Perform Build Integration Test
3.2.2.4	Create/Update PSE User's Guide
3.2.2.5	S/COMM Build 1.0
3.2.2.5.1	Design and Develop Build
3.2.2.5.2	Perform Build Integration Test
3.2.2.6	S/COMM Build 2.0
3.2.2.6.1	Design and Develop Build

Identify which detailed activities will be tracked with Progress Tracking:

Defining the requirements (Requirements Phase)

Developing the Preliminary Design (Design Phase)

Developing the Detailed Design (Design Phase)

Each separate component build (Development Phase)

Use an EV tool or Point Counting Spreadsheets to determine status on the activities identified

What's Left Goes in the Detailed Schedule

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Items from Progress Tracking are in shaded boxes

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3.2.2.6.1	Design and Develop Build

Detailed schedule items are shown in black

See http://software.gsfc.nasa.gov/tools.cfm for a Schedule Tool.

Scheduling Tool Icons

On the high-level schedule, use the duration line below to show the start and stop of a scheduled activity.

Duration Line:

On the detailed schedule, use the scheduled work line below to show the start and stop of a scheduled activity.

Scheduled Work:

Track progress against this scheduled work line by overlaying the completed work line below, adjusting the length of the completed line as appropriate to show progress.

Completed Work:

An example of a partially completed schedule activity is shown below:

On the detailed schedule, use the delayed / late work line below to show work that was planned to start but has not yet started.

Delayed / Late Work:

An example of a delayed start for a scheduled activity is shown below:

On both the high-level schedule and the detailed schedule, use the scheduled event triangle to indicate milestones that are scheduled to complete at a given date as shown below:

Scheduled Event:

On both the high-level schedule and the detailed schedule, use the delayed/late event triangle to indicate milestones that are not completed on time as shown below:

Delayed / Late Event

On both the high-level schedule and the detailed schedule, use the completed event triangle to indicate milestones that are completed as shown below:

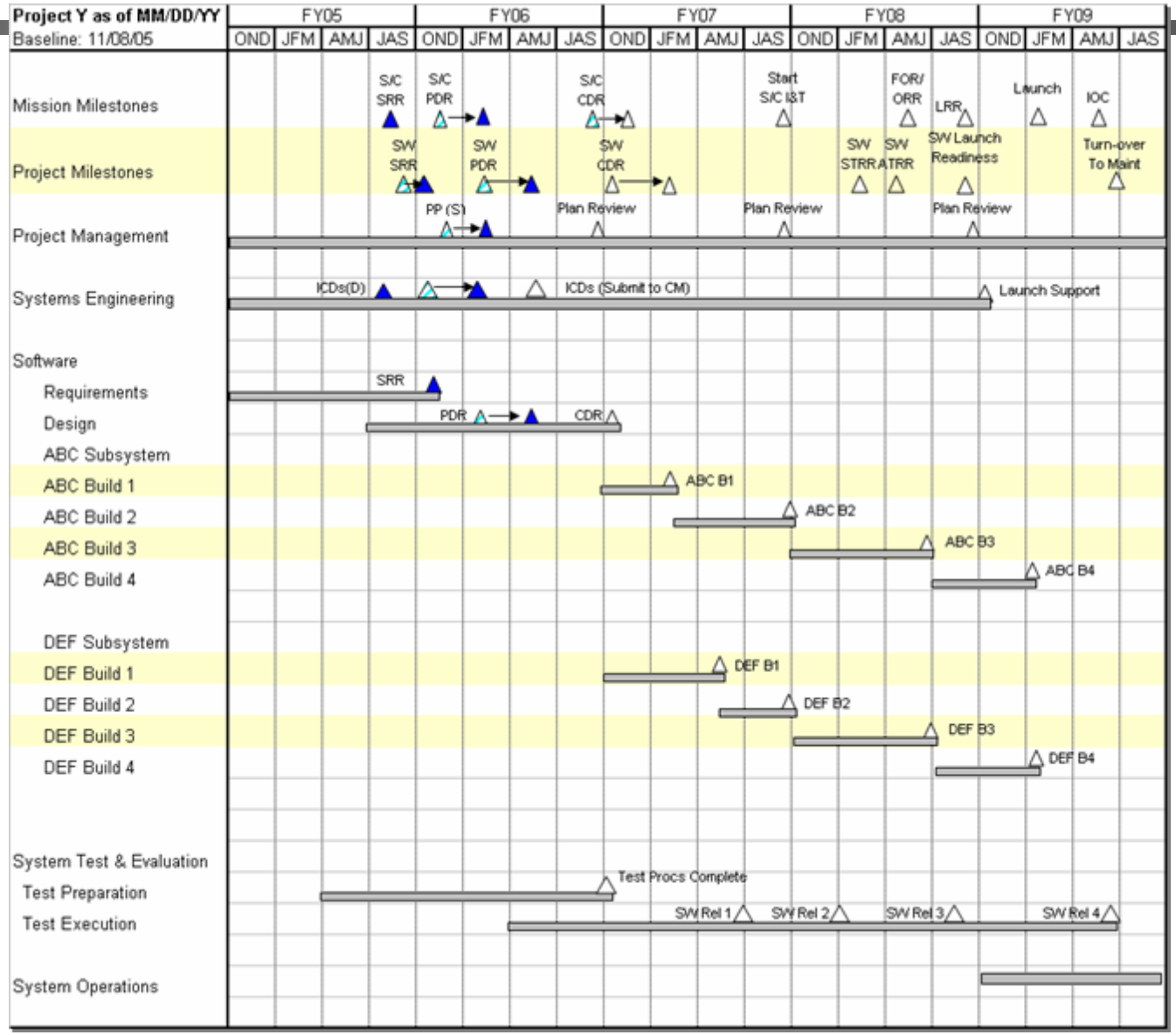
Completed Event

On the detailed schedule, internal and external dependencies can be shown using the following icons:

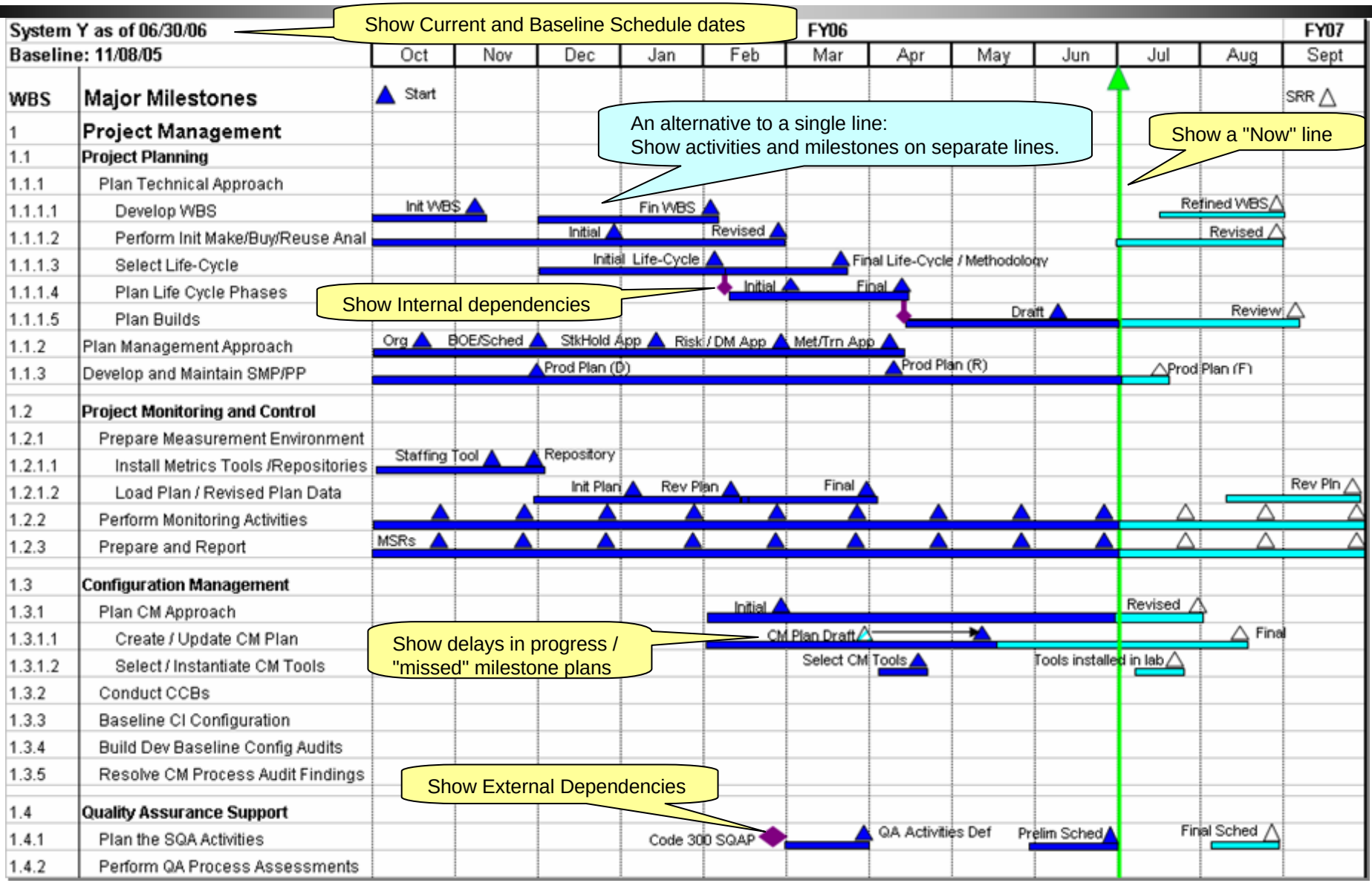
Internal Dependency:

External Dependency:

The Schedule Tool – High Level Schedule



The Schedule Tool – Detailed Schedule

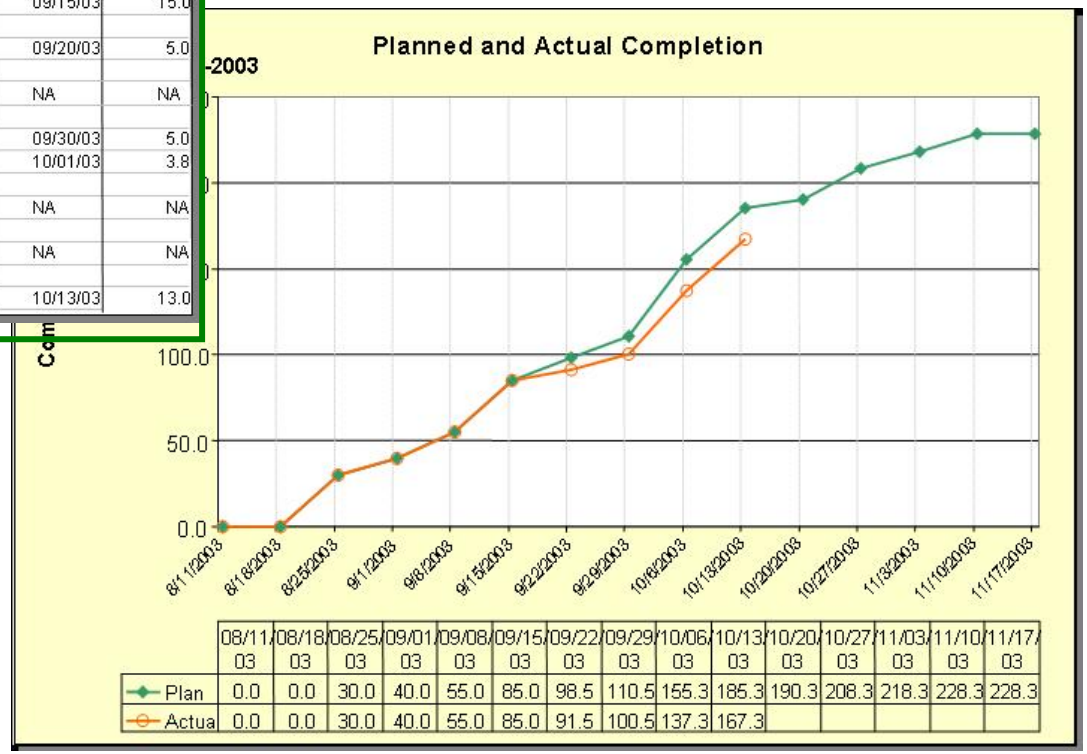


The Point Counting Schedule

Group	Task	Points	Start	Planned Finish	Actual Finish	Points Earned
	Build 1					
	GUI Dialogs (Layout)					
a	Menu Bar	15	08/04/03	08/22/03	08/22/03	15.0
a	Tool Bar	15	08/18/03	09/05/03	09/09/03	15.0
a	Resources	6.5	09/01/03	09/19/03	09/22/03	6.5
a	Missions	15	09/19/03	10/09/03	10/07/03	15.0
a	Spacecraft Setup (Orbit)	10	08/04/03	08/26/03	08/26/03	10.0
a	Solar System	15	08/25/03	09/12/03	09/12/03	15.0
a	Propagator/Force Model Setup	15	08/04/03	08/22/03	08/22/03	15.0
a	Propagate Command	15	08/25/03	09/12/03	09/15/03	15.0
	Spacecraft					
i	Core Vehicle Class	5	09/15/03	09/22/03	09/20/03	5.0
	Propagator Setup					
j	PropSetup Class	10	10/05/03	10/12/03	NA	NA
	Propagator					
k	Propagator Base Class	5	09/24/03	09/30/03	09/30/03	5.0
k	Runge Kutta89 (Verner)	3.75	09/24/03	09/30/03	10/01/03	3.8
	StoppingCondition					
l	SC Base Class	5	10/01/03	10/07/03	NA	NA
	Small set of Build 1 cond's					
m	SingleValueStop	3	10/08/03	10/10/03	NA	NA
	Interpolator					
n	Interpolator Base Class	13	10/02/03	10/13/03	10/13/03	13.0

Very detailed activities are listed with planned start and end dates, plus the "value" of each activity in points

As you track progress and enter the actual end dates, you earn the points for activities completed



	08/11/03	08/18/03	08/25/03	09/01/03	09/08/03	09/15/03	09/22/03	09/29/03	10/06/03	10/13/03	10/20/03	10/27/03	11/03/03	11/10/03	11/17/03
Plan	0.0	0.0	30.0	40.0	55.0	85.0	98.5	110.5	155.3	185.3	190.3	208.3	218.3	228.3	228.3
Actua	0.0	0.0	30.0	40.0	55.0	85.0	91.5	100.5	137.3	167.3					

The tool provides a plot of the planned progress and the actual progress

But You're Not Done Yet …

- **Validate your schedule**
  - **Specify timeframes by "backing into" the schedule based on mission schedules (top down scheduling)**
  - **Validate through "bottom up" scheduling**
- **The first cut at a schedule may need to be revised based on**
  - **Milestones with dependencies on external organizations**
  - **Activities with dependencies and critical path activities**
  - **Planned activity durations that are too short (or too long)**
  - **Adjustments to the WBS (new, modified, or deleted WBS elements)**
  - **Staffing feasibility**

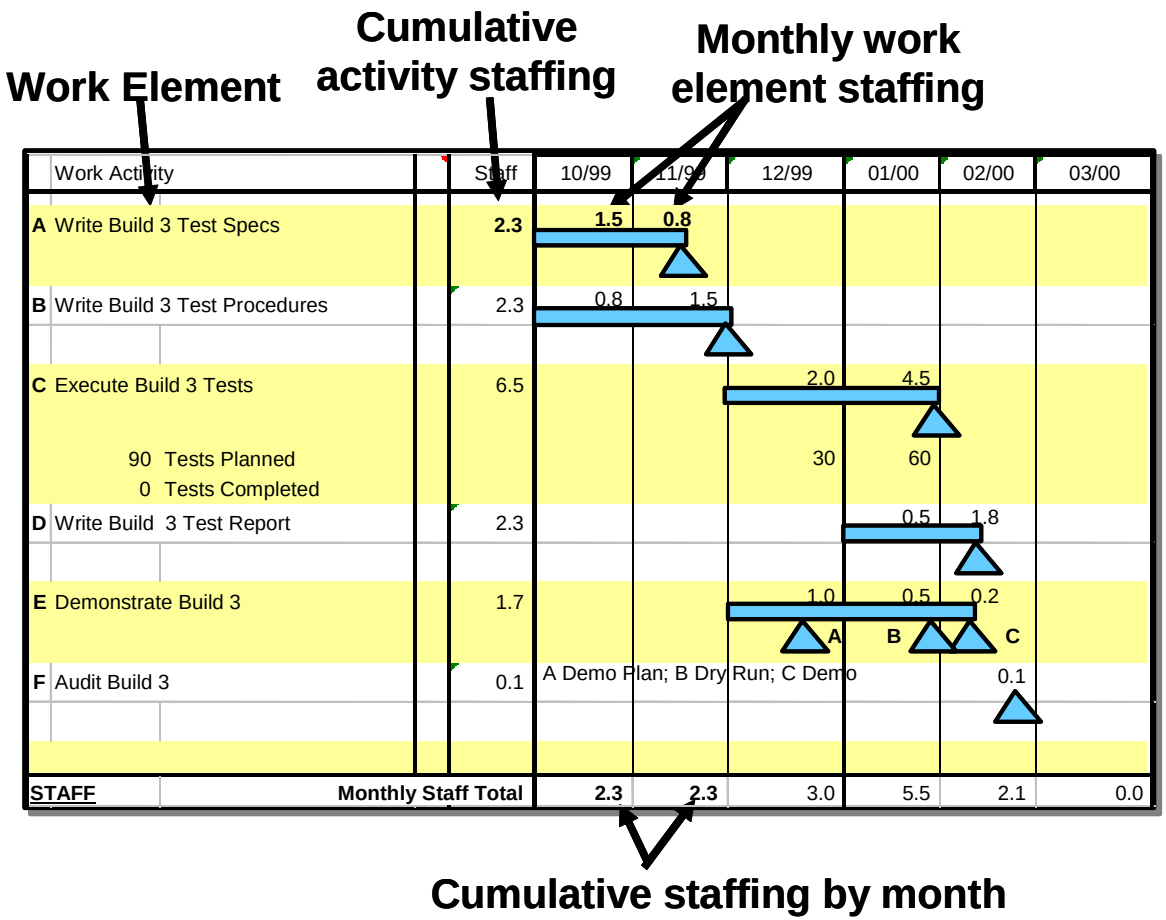
Why Is My Staffing Profile Important to My Schedule?

- Have you ever see a project where
  - The people weren't there when the work activity supposed to be done?
  - The number of people at the time was right, but their skills were wrong?
  - The people and work plans fit, but you couldn't get people on board fast enough
  - …or move them off fast enough?
- These problems frequently happen because the work plans (schedule) and staffing plans are not consistent or not feasible
- You need to make sure your staffing plan looks reasonable *and* that it's consistent with the work

First Establish Planned Staffing Size

First map your estimated resources over time to work

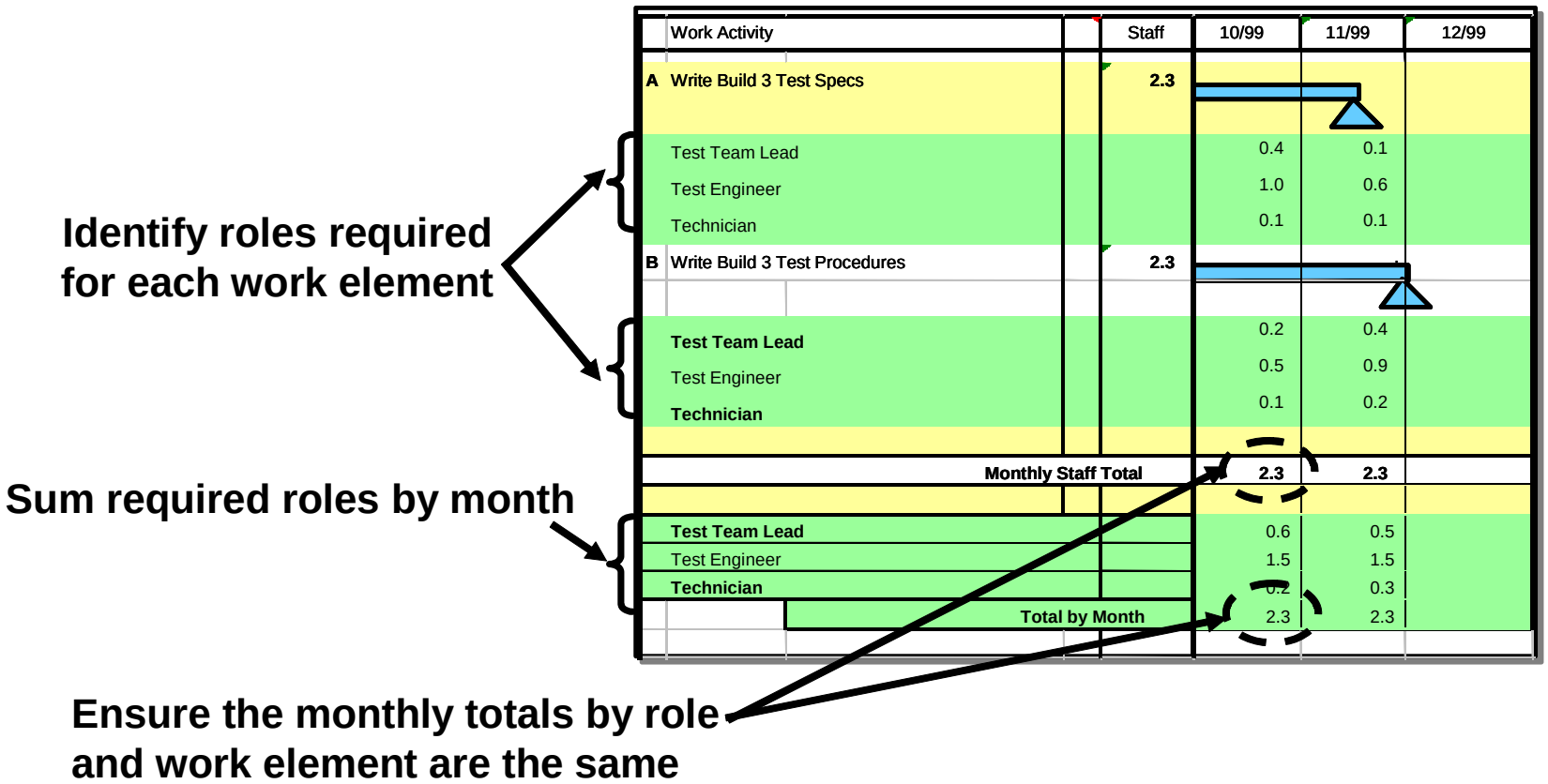
- **Map at lowest work element and sum to higher work element**
- **Reconcile estimates with mapping**
- **Use a tool (e.g., a spreadsheet)**



Then Identify the Roles Needed

Map project roles to work elements

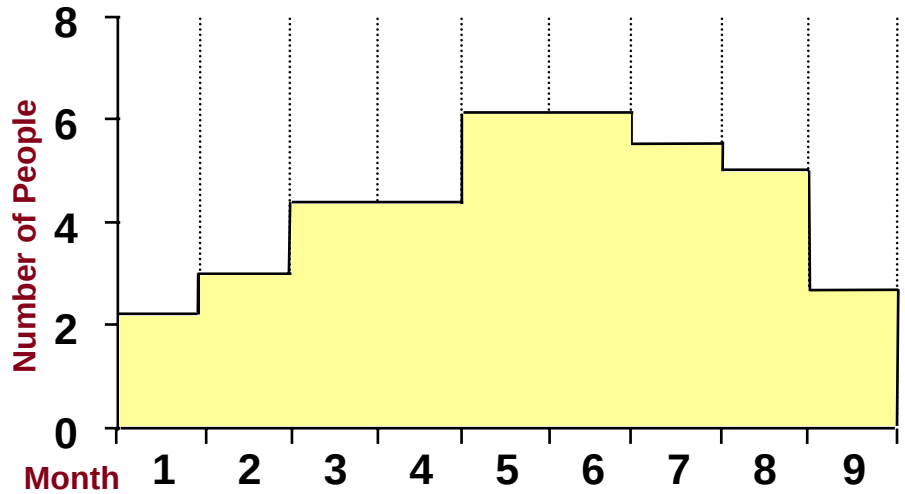
- Identify roles needed by work element and by month
- Reconcile total by work element with total by role



Reconcile the Overall Staffing Profile

Check your overall staffing profile

- Check the ramp-up and ramp-down of your project
- Check for troughs and peaks
- Add monthly requirements for all work elements by role
- Adjust schedule and role mix as necessary



Product Team Lead	.5	.5	.5	.5	.5	.5	.5	.5	.5
Development Team Lead	1.0	1.0	1.0	1.0	1.0	1.0	.8	.8	.8
Development Engineer	.5	1.0	2.0	2.0	2.0	2.0	1.0	1.0	.1
Test Team Lead	.0	.0	.3	.3	1.0	1.0	1.0	1.0	.5
Test Manager	.1	.3	.5	.5	1.0	1.0	1.0	.7	.2
Test Engineer	.0	.0	.0	.0	.5	.5	1.0	1.0	.5
Totals	2.1	2.8	4.3	4.3	6.0	6.0	5.5	5.0	2.6

Establish Your Project Organization

- Create your project organization chart
- Map responsibilities for each work element into your organization
- Identify the reporting mechanisms
- Identify the specific staff

Document Project Responsibilities

- Document the individual who is responsible for each WBS work element
- Document who will contribute to the work element
- Document the total staffing allocation for each work element
- Make sure responsible party has agreed to schedule and staffing allocations

Use the Schedule to Monitor Progress

- **On a monthly basis:**
  - **Track (i.e., show) actual progress against your planned schedule**
    - **Get progress data from your measurement activities**
  - **Analyze your progress**
    - **Is there a variance?**
    - **What is causing the variance?**
    - **What schedule adjustments should I make?**
  - **Show any resulting schedule adjustments as "projections" in the "out" months of the schedule**
    - **Use unique indicators on your schedule to show projected delays**
  - **Record your reasons for changes to the baseline schedule**
  - **Report your analysis results as part of your Branch Status Review (BSR)**

Keeping Records

Products of the scheduling process that should be kept in the project data stores:

- **Drivers for the schedule**
  - Scheduling constraints
  - Identified dependencies and critical path items
  - Estimated effort at high WBS levels
- **Results of the scheduling process**
  - Effort allocations for each WBS element
  - Staff allocation to each WBS element, including person responsible
  - Staffing profile

Avoid the Scheduling Pitfalls

- Make sure you have sufficient milestones to assess performance
- Recognize, document, and monitor schedule dependencies
- Keep upper and lower level schedules consistent with each other
- Get rid of peaks and troughs in your staffing plan
- Get rid of any steep ramp up or ramp down in your staffing plan
- Clearly define who is responsible for each work element

Schedule Summary

- **Create your project's schedule as part of your *Initial Baseline Plan*:**
  - **Include the baseline date**
  - **Include lifecycle phase activities and milestones**
  - **Include both technical and support milestones**
  - **Include "special" milestones for dependencies on other organizations**
  - **Ensure level of detail is such that progress can be objectively measured**
  - **Identify any schedule risks**
  - **Document your schedule in your in a tool such as MS Project or the Schedule spreadsheet / tool for creating and maintaining schedules**
- **For each *Replan* that affects schedules:**
  - **Document the changed schedule in your schedule tool and your Product Plan**

Questions?

Acronyms Used in This Presentation

- WBS – Work Breakdown Structure
- EV – Earned Value
- BSR – Branch Status review